Dec. 23, 1941. W. H. WILCOX ET AL 2,267,515

FLUID CONTROL VALVE

Filed Jan. 19, 1940

Fig. 1

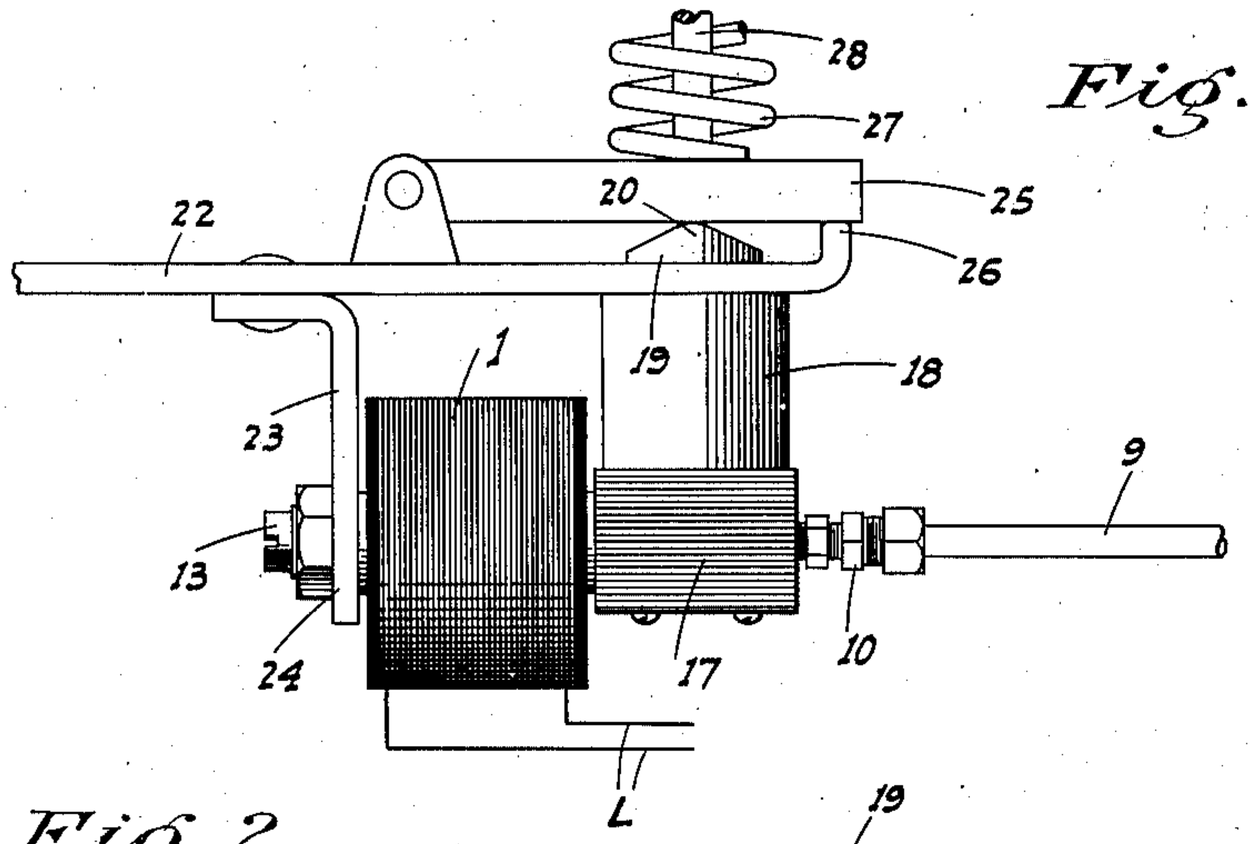


Fig. 2

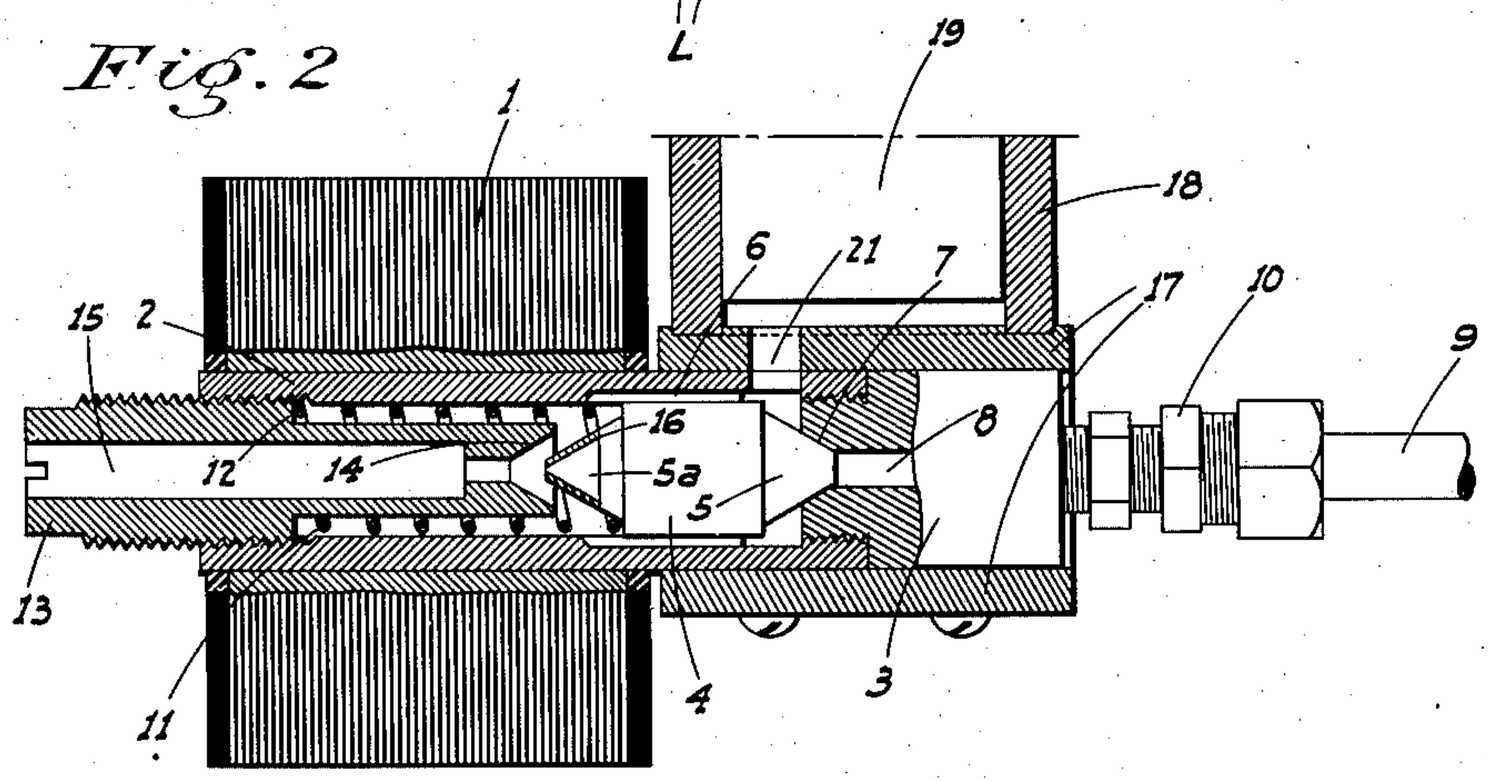
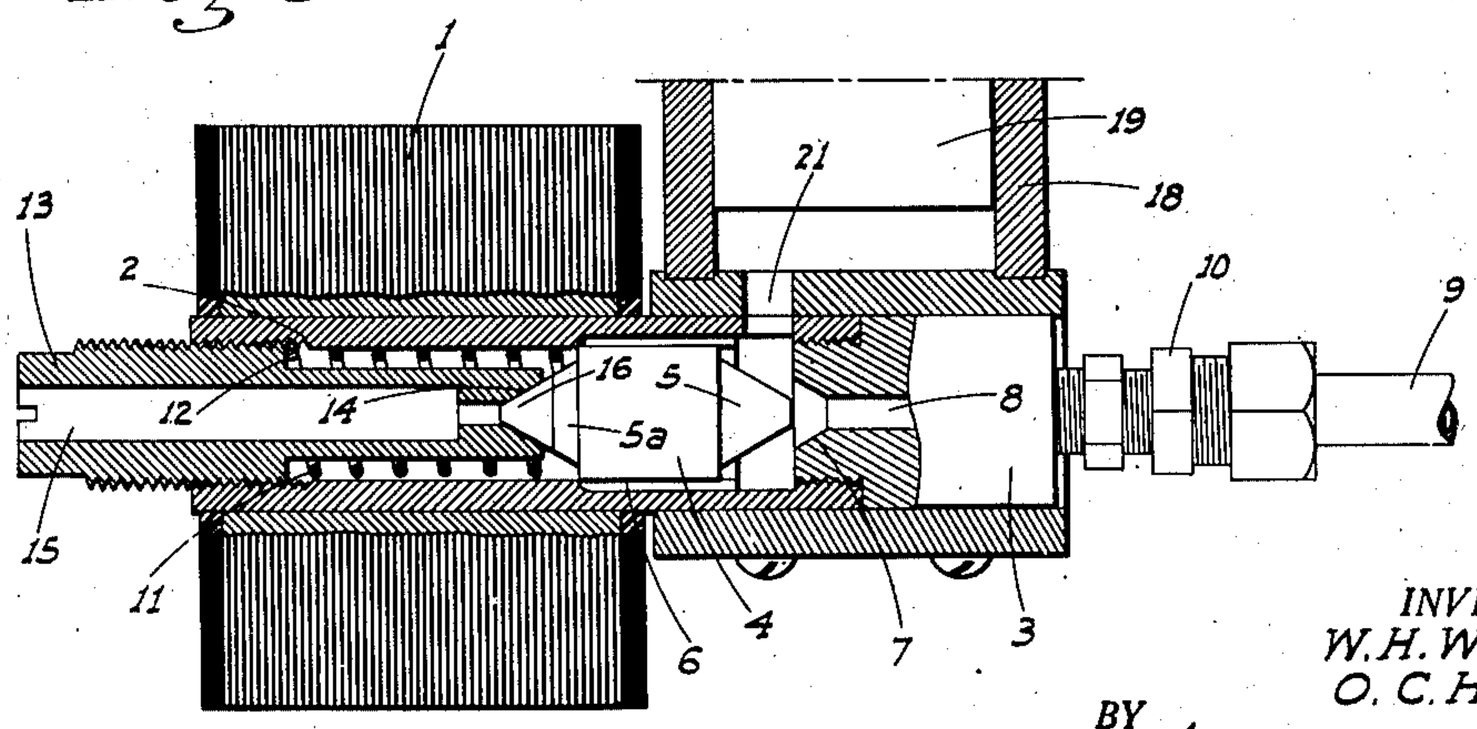


Fig. 3



INVENTORS
W. H. Wilcox
O. C. Hagan

BY Webster & Webster
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,267,515

FLUID CONTROL VALVE

William H. Wilcox and Owen C. Hagan, Stockton, Calif., assignors to California Cedar Products Company, a corporation

Application January 19, 1940, Serial No. 314,606

5 Claims. (Cl. 137—139)

This invention relates generally to a fluid control valve, and in particular is directed to an electrically actuated control valve adapted to be interposed between a source of compressed air and an air actuated power mechanism.

The principal object of the present invention is to provide an electrically actuated fluid control valve which will operate at extremely high speed; the valve in actual test having opened and closed 1500 times per minute. A valve having such characteristic is of universal adaptation, and particularly in connection with automatic, high speed production machines.

Another object of the invention is to provide a fluid control valve which, while being practically instantaneous in operation, functions smoothly and quietly, and with a minimum of vibration, as is desirable.

A further object of the invention is to provide a fluid control valve which may be mounted in a relatively inaccessible position and yet be operated electrically from a remote point.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects we accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawing similar characters of reference indicate corresponding parts in the several views:

Figure 1 is a side elevation of the valve as in use.

Figure 2 is an enlarged, fragmentary, sectional elevation with the valve in its normally closed position.

Figure 3 is a similar view, but with the valve in open position.

Referring now more particularly to the characters of reference on the drawing, the device comprises an electro-magnetic or solenoid coil 1 wound about a tubular core 2 of non-magnetic material such as brass; such core 2 projecting some distance beyond one end of the coil 1 as shown.

The outer end of the projecting portion of core 2 is fitted with a screw plug 3 which in turn projects axially from said portion of the core; the plug beyond the threaded end thereof being the same diameter as said core. This plug is likewise of a non-magnetic material.

A cylindrical, reciprocating valve 4, preferably of steel or other magnetic metal, is disposed in the tubular core and mainly in the projecting portion thereof, or, in other words, offset from the center of length of the coil; said valve being double ended, with the ends formed as taper valve heads 5 and 5*a*. The portion of the core in which the valve reciprocates has longitudinal air by-pass grooves 6 cut therein in circumferentially spaced relation.

The taper valve head 5 of valve 4 is normally engaged in a corresponding taper seat 7 formed in the adjacent end of plug 3; there being an air passage 8 bored axially through said plug from the seat 7, and an air supply pipe 9 is connected by suitable fittings 10 with said bore. The valve 4 is held in such normal position by means of a helical compression spring 11 in the tubular core, and disposed under compression between the end of the valve from which taper head 5*a* projects and a shoulder 12 on an adjustment stem 13 screwed into the adjacent end of the core. The tapered head 5*a* at its inner end is of substantially less diameter than the diameter of the body of cylindrical valve 4 whereby to form an annular shoulder for the reception of the adjacent end of said spring. Inwardly of shoulder 12 the stem extends within the spring to a point adjacent but normally spaced from valve head 5*a*. The inner end of said stem is formed with a taper seat 14, and an axial bore 15 leads from the seat to the outer end of said stem. The face of taper head 5*a* is sheathed—as shown at 16— with a non-magnetic metal to prevent "sticking" of said head with valve seat 13 which is of a magnetic metal.

An initially split base 17 of steel surrounds the exposed or projecting portion of core 2 as well as the plug 3; such base supporting a steel cylinder 18 disposed radially of said core. A plunger 19 is disposed in the cylinder and projects from the open end thereof as at 20. A radial port 21 connects between the cylinder and the interior of the core at a point adjacent the inner end of plug 3.

The device is supported by a frame member 22 secured on the cylinder 18, and including a lateral bracket 23 through which stem 13 projects, a nut 24 clamping the bracket against the adjacent end of the core.

In the present embodiment, the plunger 19 actuates a lever 25 pivoted on member 22 and normally urged toward a stop 26 by a compression spring 27; the mechanism actuated by the plunger through said lever, including a rod 28. However, it is apparent that different forms of

power mechanisms may be substituted for cylinder 18, plunger 19, and the actuated elements 25, 27 and 28.

Operation

In the operation of the hereinbefore described fluid control valve, the pipe 9 is connected with a source of compressed air or other fluid, while the leads L of coil 1 extend to and are connected with a source of current; one of said leads having a normally open make and break switch, either mechanical or electrical, interposed therein.

With closing of such switch and energization of coil 1, a magnetic field is at once created. When this field is created, valve 4 snaps in a direction toward stem 13 which breaks tapered valve head 5 from seat 7 and simultaneously engages tapered valve head 5*a* in seat 14 in closing relation therewith. When this occurs the compressed air from pipe 9 flows instantaneously through passage 8 and into the adjacent end of tubular core 2, and thence passes through port 21 into cylinder 18 where it actuates plunger 19.

As the switch breaks open and de-energizes coil 1, the magnetic field fails and valve 4 reciprocates to its normal position under the influence of compression spring 11; the air then being forced back from beneath spring returned plunger 20 into the adjacent end of tubular core 2, and flowing past valve 4 through grooves 6 and venting out through the bore 15 in stem 13.

The above described action of the valve is extremely rapid, and even upon high speed of the make and break of the coil circuit, the valve will not lag, but will function smoothly without skipping. The valve is therefore adaptable to many uses in connection with high speed apparatus, wherein articles or machine elements are manipulated rapidly.

By adjusting stem 13, the tension of the spring is altered, and the balance of the valve, and its consequent speed of operation, is controlled.

From the foregoing description it will be readily seen that we have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described our invention, what we claim as new and useful and desire to secure by Letters Patent is:

1. In an electromagnetic fluid control valve which includes a solenoid coil having a tubular core, means in the core forming facing but axially spaced valve seats, and a valve member disposed for reciprocation in the chamber in the core formed between said valve seats, the end portions of said member being tapered for closing engagement with said valve seats; the inner end of one of said tapered portions of the valve member being of lesser diameter than the adjacent portion of the valve member whereby to form an annular and radial shoulder, and a helical compression spring in the core surrounding said one tapered portion and seating at one end against said shoulder, said spring urging the valve member in a direction so that the other tapered portion engages with the corresponding valve seat.

2. A device as in claim 1 in which said first named means includes an adjustment screw threaded into the core at the end adjacent said one tapered portion of the valve member; the inner end portion of said adjustment screw being reduced in diameter to form another annular and radial shoulder and against which shoulder the other end of said spring engages, the inner end of said adjustment screw being formed as one of said valve seats.

3. In an electro-magnetic fluid control valve which includes a solenoid coil having a tubular core, means in the core intermediate its ends forming facing but axially spaced valve seats, a valve member disposed for reciprocation in the chamber formed in the core between said valve seats, said valve member being adapted at its ends for closing engagement with said seats, a fluid pressure intake passage in the core outwardly of and in communication with one of said valve seats, and a fluid pressure outlet passage in the core outwardly of and in communication with the other of said valve seats; a spring in the core engaging the valve member and urging the same into normal closing engagement with said one valve seat, said valve member being operative to retract from said one valve seat against said spring and to engage said other valve seat in closing relation upon energization of the coil and under the influence of the resulting magnetic field, there being a fluid outlet port in the core from said chamber, and means to bypass fluid between said port and said other valve seat when the valve member is in said normal position.

4. In an electro-magnetic fluid control valve which includes a solenoid coil having a tubular core, facing axially spaced valve seats in the core, there being a fluid outlet port in the core from the chamber formed between said valve seats, a cylindrical valve member slidably disposed in said chamber for reciprocation therein, the ends of the valve member being adapted for closing engagement with said seats, means yieldably urging the valve member into normal closing engagement with one valve seat, said valve member being operative to retract from said one valve seat against the urge of said yieldable means and to engage the other valve seat in closing relation upon energization of the coil and under the influence of the resulting magnetic field, and means to bypass fluid between said port and said other valve seat when the valve member is in said normal position; the cylindrical valve member having a close running fit with the longitudinal wall of said chamber, and said last named means comprising a longitudinal groove in said wall extending from said port toward said other valve seat, and to a point beyond the wall engaging portion of the valve member when the latter is in said normal position.

5. In an electro-magnetic fluid control valve which includes a solenoid coil having a tubular core, facing axially spaced valve seats in the core, there being a fluid outlet port in the core from the chamber formed between said valve seats, a cylindrical valve member slidably disposed in said chamber for reciprocation therein, the ends of the valve member being adapted for closing engagement with said seats, means yieldably urging the valve member into normal closing engagement with one valve seat, said valve member being operative to retract from said one valve seat against the urge of said yieldable means and to engage the other valve seat in closing relation upon energization of the coil and under the influence of the resulting magnetic field, and means to bypass fluid between said port and said other

valve seat when the valve member is in said normal position; the cylindrical valve member having a close running fit with the longitudinal wall of said chamber, and said last named means comprising a plurality of longitudinal grooves in said wall in circumferentially spaced relation, said grooves extending from the plane of said port toward said other valve seat and to a point beyond the wall engaging portion of the valve member when the latter is in said normal position.

WILLIAM H. WILCOX.
OWEN C. HAGAN.